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OF THE
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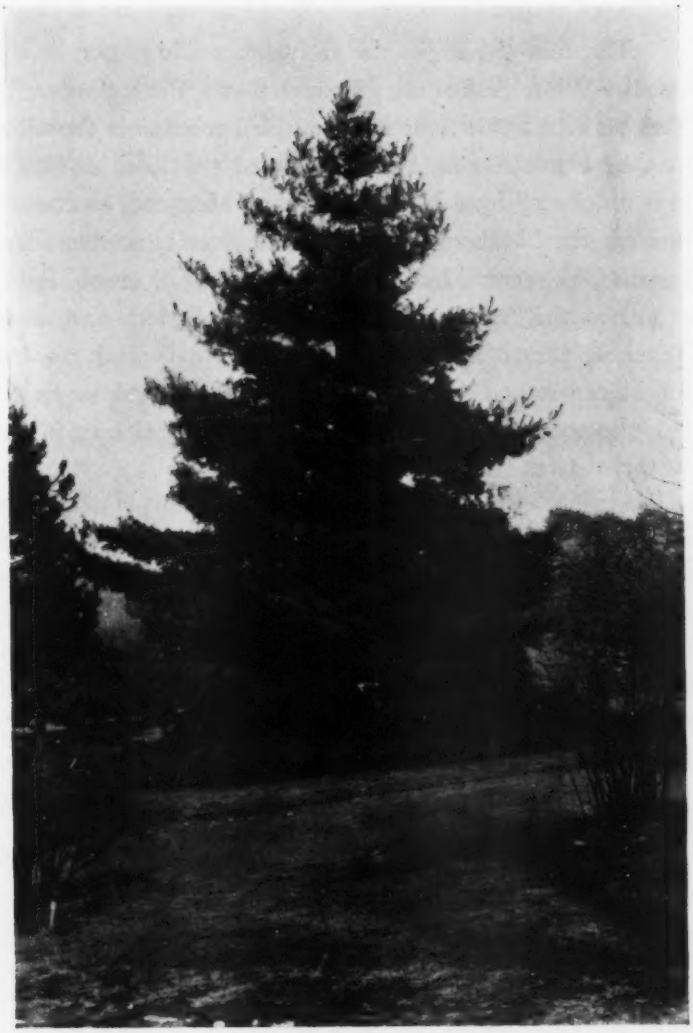

White Pine
Pinus Strobus L.

The tree shown in the frontispiece illustration is the familiar White Pine of our Northern States, *Pinus Strobus,* L. This has been a chief source of valuable lumber since the white man came to America, and has suffered greatly at his hands. It is distributed from Newfoundland to Manitoba, southward through the Northern States to Pennsylvania, northern and eastern Ohio, central Indiana, and as far west as central Iowa. It follows the Appalachian Mountains to Eastern Kentucky, Tennessee to northern Georgia (Sargent). It is much planted for its ornamental value and for its unquestioned hardiness. It is also one of the species mainly used in reforestation in the northern states.

This pine has five leaves in a fascicle, 3 to 5 inches long. The cone is from 4 to 8 inches long. The trunk is usually straight, and rises to a height of 100 feet when mature. It has been known to reach 220 feet, with a stem diameter of 3 to 4 and even 6 feet. The young specimen seen in the picture is about 30 years old. It was photographed by Professor H. H. York.

RODNEY H. TRUE

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LILACS*

—BY—

JOHN C. WISTER

Director, Arthur Hoyt Scott Horticultural Foundation, Swarthmore College

THE GENUS *Syringa,* which is the botanical name for the Lilac, belongs to the great Olive family, which includes also Privets, Forsythias, and other well-known garden shrubs. Our common Lilac (*Syringa vulgaris,* L.) comes from Hungary and Rumania, and is one of the two European species, the other being *Syringa Josikaea,* Jacq. Practically all of the other species are from the far east with China as the headquarters. Of these eastern species, *Syringa villosa,* Vahl., was introduced from north China in 1885, *Syringa pubescens,* Turcz. in 1880, and *Syringa oblata,* Lindl. in 1856. Nearly all of the others have been discovered and introduced in the present century, most of them between 1905 and 1915. They are of great interest to botanists, but the two most important species to gardeners are *Syringa persica,* L. and *Syringa vulgaris,* L.

Syringa persica, L. was cultivated in Persia before the year 1200 and was well known in England in 1600, and in this country in 1800, but its real home is Kansu, China, where it was discovered growing wild by Meyer in 1915. This is a splendid garden shrub deserving a place in even the smallest collection.

The common Lilac has been in cultivation in northern Europe since the 16th century, having been brought there from Turkey. It was much confused by writers, however, with the Mock Orange, and even in the present day people can be found who refer to Mock Orange as Syringa.

Gerarde, in 1857, wrote: "These trees grow not wild in England, but I have them growing in my garden in very great plenty." He called it the "blew pipe tree" and noted that "older physitions do name it lillach or lilach."

Miss Keeler has stated that it was in America as early as 1652, and Dr. Harshberger has quoted Bartram, complaining in 1753 of the shipment of lilacs to him,

* Summary of a lecture given at the Morris Arboretum of the University of Pennsylvania on December 12, 1936.

because there were plants already too numerous in his garden. Mrs. McKelvey, who made the greatest study of the Lilac, states that there is no authentic record of their being in this country before 1767, in which year there is noted in Thomas Jefferson's diary, on April 2nd, that he planted Lilacs. She quotes, also, George Washington's diary of March 3, 1785.

It is curious that all the plants mentioned in these early records were of garden origin, and that no one knew the real wild home of this plant until it was found in 1828 in Rumania, and in 1841 in Bulgaria.

The cultivation of Lilacs is simple. While they will grow in any soil, they do not do well unless given ample food, either in the form of manure or commercial fertilizers. Fall planting is better than spring planting because the leaves start so very early. Much pruning is not necessary. The removal of crossing or straggly branches is usually enough at first, and as the plant gets older, an occasional old branch should be removed to give the young growth, which will bloom more freely, opportunity.

Propagation of the Lilac is by seeds, cuttings, grafting and budding. Named varieties of course will not come true to seed, and the common commercial practice is to graft them, because that is quicker than growing them from cuttings. Many gardeners have objected to the practice of grafting Lilacs on privet, and learned papers have been written to prove that this always results in the disease which has been named graft blight. Many practical gardeners, however, have succeeded admirably with these plants so propagated without undue difficulty. If the grafting is done with a long scion, and the plant the first year is placed very deep so that the top bud of the scion is at the level of the ground, own roots will form in the first year or two, and the privet stock may then be removed. This is the practice of many growers.

Plants propagated by budding are not as satisfactory, because the plants cannot be planted deeply until the lilac is a year or more old and the wood is harder. Propagation by cuttings is theoretically the best, but it takes some skill and practice to take the wood at just the right stage which, in the climate of Philadelphia, is usually about the first of July. Some growers are now resorting to root cuttings in winter and report excellent success.

Literally hundreds of named varieties are in commerce, and it is not necessary for the ordinary garden to have more than a dozen or twenty-five of these to get a representative collection. A few of the named varieties like Lovaniensis and Macrostachia are a century or more old, and there are in commerce named varieties of Dutch, Belgian and French origin, which are at least half a century old.

In general, however, most of these have been greatly surpassed by the modern kinds introduced in the last twenty-five or thirty years, nine-tenths of which are from the great firm of Lemoine, in Nancy, France. If we except the varieties Mme. F. Morel, Souvenir Ludwig Spaeth, Mrs. W. E. Marshall and President Lincoln, practically all the other varieties that I shall name are from Lemoine.

It is not possible here to give an extensive list, but I should like to urge gardeners to try the single white varieties—Vestale, Mont Blanc and Marie Finon—and the double whites—Miss Wilmott and Edith Cavell. In bluish and violet shades there are Cavour, de Miribel, Decaisne, President Lincoln, Boule Azuree and Maurice Barres in singles, and in doubles, Emil Gentil, Marechal Lannes, Olivier de Serres, President Viger, Rene Jarry Desloges, Thunberg, Henri Martin and Victor Lemoine.

On the pinkish and reddish tones in singles are Macrostachia, Lucy Baltet, Congo, Marengo, Massena and Mme. F. Morel, and in doubles, Belle de Nancy, Mme. Buchner, President Fallieres and Georges Bellair. In the deepest purple shades are Ludwig Spaeth, Monge, Rochambeau, Vulcan and Vesuve.

Any of these varieties will be found satisfactory under conditions of reasonably good drainage and open sunlight. They will not bloom well in deep shade, although the plants may survive for some time. As they all bloom in the season of the Tulips, Intermediate Irises and *Scilla nutans* and *campanulata,* many combinations of color can be made with these flowers.

I have touched on but a few of the older established varieties. Many novelties are being introduced which may be finer, and I hope that gardeners will watch for some of the newest things from Lemoine and from some of the new seedlings of the late T. A. Havemeyer, of Long Island, of Mrs. Klager, of Oregon, and Miss Preston, of Ottawa, Canada.

SUMMER INJURY TO CONIFERS AND OTHER WOODY ORNAMENTALS

JAMES LAMBERT, *Superintendent*

DURING THE PAST growing season the vegetation at the Morris Arboretum has been subjected to severe climatic changes that have caused varying degrees of injury, some of which were far above the average for this vicinity. Late frost and strong winds during the spring wrought havoc with the young, tender leaves of some deciduous trees. This was followed by a prolonged period of drought and, early in July, unusually high temperatures for this region were recorded. Then, again in the fall, a greater drought was experienced than earlier in the season.

There was a temporary browning of the grass, but no injurious effects were observed to trees and shrubs that could be traced to drought. However, both temporary and permanent injuries were sustained by plants that could be definitely traced to the abnormal heat wave of July 9th and 10th, when an official temperature of 103° F. and 104° F., respectively, were recorded by the U. S. Weather Bureau for Philadelphia. Following these high temperatures, signs of injury to young conifers growing in a fully exposed nursery were noticeable, which two days later resulted in a general browning of vegetative growth. This damage was represented by wide areas of dead foliage and branches on the south side only of the plants, or, as exhibited in two large, flat spreading Junipers, the tender tips of the highest branches were scorched as if by an open flame. By sighting these dead areas with the position of the sun, it was possible to judge that the injury occurred between 11 A. M. and 1 P. M., since other parts or sides of the plants were unaffected.

The following list of conifers, with the approximate percentage of injury, together with other species of the same genus which were uninjured, may serve as a comparative basis of susceptibility to high temperatures by direct sun rays, since all species were growing under exactly the same conditions. The plants were in a healthy normal state, unless otherwise stated. Temperatures of soil or air to which these plants were subjected cannot be ascertained, since no such records were made at the nursery in which these plants were growing.

Abies cephalonica, Loud.

1′ to 2′ spread; 90% foliage and 40% growth killed.

Abies concolor, Lindl. & Gord.

1′ to 1½′ high; 50% foliage and 10% growth killed.

Abies balsamea, Mill.

1′ to 2′ high; 5% growth at tip killed.

Abies Fraseri, Poir.

Specimen 6′ to 7′ high; 10% foliage and growth killed.

Abies homolepis, Sieb & Succ.

2′ to 3′ tall; all new foliage and 10% branch growth killed.

Abies lasiocarpa, Nutt.

1′ high; 5% foliage killed.

Picea Abies, dwarf variety.

Low 2′ to 3′ spreading; 25% foliage and branches killed.

Picea Abies, dwarf variety.

Low 2′ spreading specimen; whole south side, representing 50% of plant killed.

Picea Abies, dwarf variety.

Twenty per cent of all vegetative growth killed.

Picea Abies, Karst.

4′ to 5′; unhealthy specimen 90% killed.

Picea Koyamai, shiras.

1′ to 2′ high; 20% foliage and branches killed.

A number of 4′ to 5′ plants of Picea Abies were not affected. It is interesting to record the following species, which were not susceptible to intense heat during this period:

Picea Abies pendula, Nash.
Picea Engelmanni, Engelm.
Picea glauca Albertiana, Sarg.
Picea glauca nana, Rehd.
Picea polita, Carr.
Picea pungens glauca, Beiss.
Picea omorika, Purkyme.
Picea Smithiana, Boiss.

Chamaecyparis obtusa Crippsii, Rehd.

Small plants 6″ to 8″ high; received a foliage and branch kill from 50% to 100%.

Chamaecyparis pisifera plumosa aurea, Beiss.

6″ to 12″ high; healthy plants injured 50%, while unhealthy plants were killed 100%.

Chamaecyparis pisifera sulphurea, Schelle.

6″ to 12″; received 50% injury to foliage.

Chamaecyparis pisifera squarrosa, Beiss & Hohst.

6″ to 12″; 10% tip burn only.

The following did not receive the slightest injury:

Chamaecyparis pisifers, Endl.
Chamaecyparis filifera, Beiss.
Chamaecyparis Lawsoniana allumii, Beiss.

Thuja occidentalis Boothii.

2′ to 3′ high; 25% of foliage killed.

Thuja occidentalis Vervaeneana, Gord.

6″ to 10″; received 20% tip burn.

Growing in the same nursery rows, but uninjured, were the following:

Thuja occidentalis globosa, Gord.
Thuja occidentalis Rosenthalii, Ohlen.
Thuja orientalis, L.
Thuja orientalis, Rosedale hybrid forms.

Pinus densiflora umbraculifera, Mayr.

5′ to 6′ high; 15% terminal growth killed.

Pinus Thunbergii Parl., Pinus sylvestris, L., Pinus Banksiania, Zucc. and Pinus taeda, L. were uninjured.

Cephalotaxus drupacea, Sieb & Zucc.

Low spreading, 1′ to 1½′ wide; received 50% to 90% foliage kill.

Juniperus Chinensis Pfitzeriana, Spaeth.

Two old and large specimens growing nearby on sodded land received 10% branch tip burn of the highest branches that resembled the effect of an open flame, but no permanent injury resulted. Younger plants of *Juniperus Chinensis*, L., *Juniperus virginiana*, L. and *Juniperus communis*, L. forms, growing in the more exposed nursery were not injured.

Tsuga dumosa, Sarg. (*Tsuga Brunoniana*, Carr.) Two-year-old seedling plants, growing in a shaded cold frame, were 100% killed, while older specimens of such species as *Tsuga canendensis*, Carr., *Tsuga caroliniana*, Engelm., *Tsuga diversifolia*, Mast. and *Tsuga Sieboldii*, Carr., were unaffected. It may also be of interest to record *Taxus cuspidata*, Sieb & Zucc., and *Tsuga cuspidata nana*, Rehd., two of our hardiest types of evergreens, were also unaffected by this abnormal climatic condition.

GROWTH PROMOTING ACTION OF ETHYLENE AND OF OTHER CHEMICAL SUBSTANCES*

THE INJURIOUS EFFECTS of the gases ethylene, acetylene, prophylene and carbon monoxide, on plant growth were summarized in the last number of the Bulletin.

That these gases in some instances change the aspect of plants, by modifying the distribution of growth, was illustrated in the changed position of leaves of the tomato, causing them to turn down (epinasty).

Crocker, Zimmerman and Hitchcock, at the Boyce Thompson Institute for Plant Research, listed 202 sorts of plants, and found that 89 sorts showed this bending down of leaves under the action of the four gases named when the right concentrations were used. A test of 38 gases and vapors showed that only those named produced this extreme typical effect.

Recently investigations in Europe and in America have shown that a similar effect may be induced by a number of non-gaseous substances when applied to plants in water solution, or in mixture in wool fat (lanolin). The best known of these non-volatile substances is one found by European investigators and known by the name of hetero-auxin. Hetero-auxin, (indole 3-n-acetic acid) phenylacetic acid, and naphthalene acetic acid, as well as some other acids and derivatives of these hetero-cyclic groups, call forth the responses. The leaf response (epinasty) is produced typically by several of these growth-promoting materials.

The four gases named induce mature cells of plants to resume the embryonic condition seen in the growing state. This is specially true of the cortex cells lying near the surface of the stem or root. These rejuvenated cells increase in number and grow in size producing swellings (intumescences). Dr. Wallace has shown that one part of ethylene gas to 100,000,000 parts of air will induce intumescence formation in apple twigs. Assuming that the ethylene dissolves in the sap of the apple twig in the same proportion that it dissolves in water, it seems that the minimal concentration of ethylene needed to produce intumescences would be one part by weight in 650,000,000,000 parts of apple twig. This is probably the most sensitive biologi-

* Abstract of a part of Dr. Crocker's lecture delivered at the Arboretum on April 11, 1936.

cal response to a chemical substance known to date. On a percentage weight basis, ethylene is nearly 10,000 times as effective as hetero-auxin, and on the molecular concentration basis, about 1000 times as effective. The low concentrations in which ethylene induces developmental changes recall the similar characteristics of vitamins and hormones.

Zimmerman and Hitchcock have recently shown that hetero-auxin and other indole, phenyl and naphthalene compounds that produce physiological effects similar to hetero-auxin, produce intumescences much as do the four gases mentioned above.

The presence of traces of ethylene induces many chemical changes in plants. It hastens the decomposition of the characteristic green pigments (chlorophyll) in the leaves and other living tissues. This property is made use of commercially to hasten the coloring of citrus fruits, the blanching of celery, the ripening of bananas, tomatoes and other fruits.

Zimmerman, Crocker and Hitchcock first discovered the profuse initiation of roots by a known and single chemical, carbon monoxide, a property shown later to be shared with the four gases mentioned before. The same property was found to belong to the water-soluble indole, phenyl and naphthalene compounds already mentioned. The practical value of this property in commercial plant propagation seems likely to have great significance. These substances induce profuse root initiation, apparently speeding up the rooting processes, aiding in the case of plants hard to propagate by cuttings. It is possible that in some cases this may supplant the use of grafting and budding methods. In practice, the water solutions of the non-volatile chemicals or suspension of the chemicals in wool fat (lanolin) are preferable to the use of the gases because their action can be thus localized to places where roots are wanted and small quantities of the materials produce the desired results.

The prolonged effect of these growth-promoting substances may reduce growth after having once started it. Hence, proper concentrations of these substances and times of exposure of the cuttings to the solutions have to be worked out if the helpful action alone is to be gained. The starting of root hairs, as well as of roots, is favored by the gases named.

Studies by a number of investigators show that ethylene is produced normally by various plant tissues and organs, including apples, potatoes, celery, and even by

flowers and by leaves and stems of plants, and it seems logical to conclude that it acts in some plants as a natural hormone.

SUMMARY

Three general groups of substances in illuminating gas and their effects on plants have been discussed.

Hydrocyanic acid dissolves in the water of the soil and kills the root system of the trees. Gas companies can reduce the amount of injury done to trees by illuminating gas by scrubbing the gas free from hydrocyanic acid. After hydrocyanic acid has accumulated in the soil, its rate of disappearance can be hastened by aerating or leaching the soil. It also gradually disappears from the soil due to action of organisms.

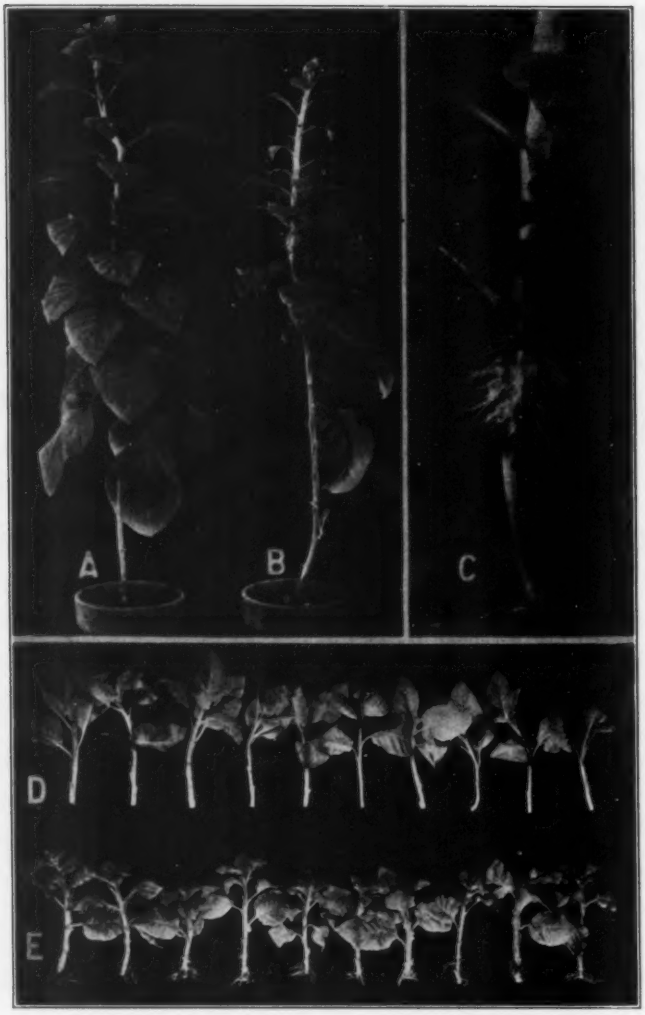
Condensation of drip oils in the soil constitutes the second greatest source of injury to trees in the soil. The less volatile of these remain in the pipes or in the immediate region of the leak. Their removal from the soil can be hastened by aeration and naturally occurs by volatilization.

The third group of substances considered are the gases which show low solubility in water. Amongst these, four unsaturated carbon-containing gases (ethylene, acetylene, propylene and carbon monoxide) are of special interest because of their anaesthetic and stimulative effects on plants. Ethylene is of special interest because of the extremely low concentrations in which it shows anaesthetic and stimulative action.

The anaesthetic effects of these four gases are manifested by partial or complete growth rigor. The following stimulative effects are outstanding: induction of epinasty of petioles, induction of intumescences, initiation of roots and root hairs. In the anaesthetic effects and especially in the stimulative effects, the four gases act similarly to hetero-auxin and other non-volatile, growth-stimulating and modifying substances.

Ethylene is produced by various plant tissues and probably acts as a natural hormone in plants.

WILLIAM CROCKER



LEGENDS FOR FIGURES

Figure 2

Nicotiana tabacum (Turkish variety) exposed to one per cent carbon monoxide gas. A. Control plant kept in Wardian case. B. Plant exposed to gas 15 days, then allowed to stand in air two days, after which time it was photographed. C. An enlargement of the rooting region of B. D. Tobacco cuttings from control plants in Wardian case for 10 days. Photographed 5 days after having been placed in rooting medium. E. Cuttings from plants treated with one per cent carbon monoxide for 10 days and then placed in rooting medium for 5 days, after which time they were photographed.

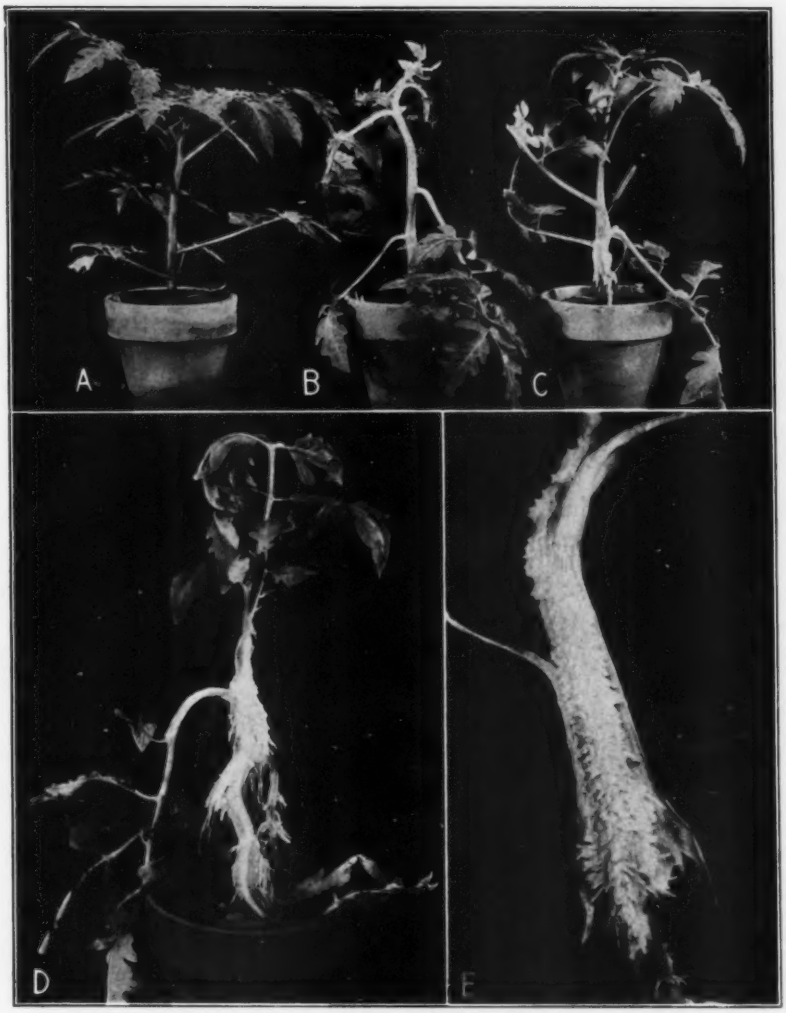


Figure 3

Tomato plants treated with growth-promoting substances. A. Control. B. Plant 24 hours after treatment along the stem with lanolin paste containing one per cent a-naphthaleneacetic acid. C. Approximately 0.4 cc. of 0.01% a-naphthaleneacetic acid in water injected by means of a glass tube caused local epinasty and initiation of roots; appearance after 8 days. D. Stem and leaves of plant treated with lanolin paste containing 2.0 per cent a-naphthaleneacetic acid. E. Adventitious roots on stem 14 days after treatment with 2.0 per cent indoleacetic acid.

EROSION

EVER SINCE the solid ground rose above the waters, two groups of forces have been at work on it. One has for its net result face-lifting, with the elevation of mountains, plateaus, and other high places; the other has resulted in the lowering of the land. The processes that have worn down the land are now attracting much attention on account of the tremendous influence that they are recognized to have on the fate of us humans.

Weathering processes, such as heat and cold and the dissolving action of water, have broken down the rocks into fine particles that have become subject to the action of the forces of erosion, wind and water. The movements of air currents, winds, pick up these rock particles and carry them as dust as long as the force of the wind will permit. Then they are deposited as the wind speed falls, the heavy particles being deposited first, the finer ones later. Sometimes the finest particles are carried into the upper levels of the atmosphere, where they continue to travel long distances as dust clouds. During the past dry seasons, the fine farm soils of the wheat belt beyond the Mississippi have clouded the skies of the Eastern States, and winds have even borne the dust hundreds of miles out over the Atlantic Ocean. Vast quantities of productive farm soil have been carried away, and vast damage has been done to American agriculture.

The impact of falling raindrops on unprotected surfaces, especially when driven by wind, dislodges soil particles, suspends them, and, as streams begin to form, transports these loose particles downstream. Thus, on unprotected soil surfaces, on farm lands in which the handling of the soil leaves it subject to wash, the valuable top soil, in which farm and garden plants grow, tends to wander with the flowing water. As the water begins to form larger and larger streams, the action becomes more and more pronounced and injurious. Gulleys begin to form, and these widen and deepen, forming gutters that tend to work back into the adjoining areas. The transported particles, carried along in the muddy stream, are deposited as the force of the current is reduced, the heavier particles being dropped first, forming gravel banks, sand bars and silt beds. Finally, the smallest particles slowly settle in standing water. By this general process, the farm soil of the upper waters of the river basins

is removed, sorted and deposited along the lower stretches of the rivers, interfering with navigation, silting up reservoirs, or spreading out over inundated flat lands. Much may even go out to sea to form deltas at the mouths of the larger rivers.

The processes of wind and water erosion have been going on since the rocks forming the earth's surface were weathered into transportable particles, but the plant cover of grasses, shrubs and trees protected the soil to a great degree. With the clearing away of the forests, with bad soil management by the farmer, with the over-grazing of the grass lands, with damage to the protecting forest and sod, the soils of this country from which we get food, fibres, timber, and endless products used in manufacture, are being damaged to an extent that is almost appalling.

A soil survey reported by Sears (Deserts on the March, p. 99) classified the soils of the country according to their quality for agricultural use. The results are as follows:

Excellent—	**5.3 per cent**	**Poor**	**—19.1 per cent**
Good	**—11.1 " "**	**Unfit**	**—46.4 " "**
Fair	**—18.1 " "**		

Of course, much of the *unfit* land has not become so through erosion, e.g., marsh lands, mountain areas, and others. This survey reveals a situation that has hardly been more than suspected.

The remedy for eroded lands lies partly with engineering work that shall have for its aim the retarding of the flow of water, with an increase in the quantity of water absorbed and stored in the ground; partly with the user of the soil, who should so plow his furrows as to hinder the flow of water, and who should plant and handle his crops with this same object in view. The planting of trees to retard the formation and flow of streams at the head waters and to promote absorption by the soil of water at the point of rainfall, is an important upstream measure. Trees by their root systems help to hold the soil on woody slopes. Grasses everywhere, by retarding stream formation and stream flow, and by the retaining action of their fibrous root systems, give most important protection.

R. H. T.

WINTER LECTURES

THE WINTER lecture course to be given at the Arboretum during the coming season will deal with the general subject of "Flowering Trees and Shrubs." Speakers specially equipped to deal with these groups have been obtained and all persons in these types of plants will find the lectures worth hearing.

The schedule of dates, subjects and speakers follows:

December 12, 1936.

MR. JOHN C. WISTER — *Lilacs*

Mr. Wister is Secretary of the Pennsylvania Horticultural Society, Director of the Arthur Hoyt Scott Foundation of Swarthmore, and author of several well-known books.

January 9, 1937.

DR. L. M. AMES — *Barberries*

Dr. Ames, attached to the Bureau of Plant Industry, of the U. S. Department of Agriculture, has been carrying on extensive investigations at the Arnold Arboretum, of Boston, Mass.

February 13, 1937.

MR. A. D. SLAVIN — *Magnolias*

Mr. Slavin comes to us from Des Moines, Iowa, where he is engaged in work with the National Government. He will be remembered for his earlier work at the Arboretum of Rochester, New York.

March 13, 1937.

DR. GLEN P. VAN ESELTINE — *Flowering Crab Apples*

Dr. Van Eseltine is now connected with the Horticultural Department of the New York Agricultural Experiment Station at Geneva, New York. His publications on the subject of his lecture will be recalled.

April 10, 1937.

DR. DONALD WYMAN — *Flowering Trees and Shrubs Pictured in Their Order of Bloom*

Dr. Wyman comes from the Arnold Arboretum at Boston, with a remarkable exhibit of slide illustrations in natural colors that have been developed there at much expense of time and money.

Lectures will be given at 2:30 P. M. on the second Saturday of the month, at the Arboretum. Entrance by the Meadowbrook Lane gate.